UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/676,011	09/29/2000	Ron P. Maurer	1006310-1	9252

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EXAMINER
EDWARDS, PATRICK L

ART UNIT	PAPER NUMBER
2621	

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No. 09/676,011	Applicant(s) MAURER, RON P.
	Examiner Patrick L Edwards	Art Unit 2621

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-34* is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-3,8-12,17-19,23-25 and 29-31* is/are rejected.

7)☒ Claim(s) *4-7,13-16,20-22,26-28 and 32-34* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All b)☐ Some * c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

    a)☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *4* .

4)☐ Interview Summary (PTO-413) Paper No(s). _____ .

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102

1.   The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis

for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2.   Claims 1 and 29 are rejected under 35 U.S.C. 102(b) as being anticipated by Lee et al. (US Patent

Number 5,361,308).

With regard to claim 1, Lee discloses clipping pixel intensity values outside of a variable range

and mapping pixel intensity values within the variable range (Lee column 5 lines 20-29). The linear ramp

disclosed in Lee maps pixel intensity values within the range. The pixel intensity values outside this

range are clipped. Lee discloses that this range is defined by low and high clipping points which vary

according to the intensity levels of the background and object area, respectively. Consequently, the

mapping and clipping operation are done in accordance with a variable range.

With regard to claim 29, a program stored in memory which causes the computer to execute the

steps of a method is essential if the image processing method disclosed in Lee is to function. Therefore, a

program stored in memory is inherent in the teachings of Lee.

3.   Claims 10 and 17 are rejected under 35 U.S.C. 102(b) as being anticipated by Zimmerman et al.

("An Evaluation of the Effectiveness of Adaptive Histogram Equalization for Contrast Enhancement").

With regard to claim 10, Zimmerman discloses determining a dynamic range of a pixel

neighborhood, where the dynamic range of a pixel neighborhood is based on a difference of minimum

and maximum pixel values in the pixel neighborhood; and then performing contrast stretching on a pixel-

by-pixel basis according to the corresponding dynamic range (Zimmerman pg. 305 left column, final

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paragraph). The "distribution of pixel intensities" as disclosed in Zimmerman is analogous to a dynamic

range based on a difference of minimum and maximum pixel values as recited in the claim. The

difference between the minimum and maximum pixel values of a region is well known in the art as the

distribution of pixel intensities for the region. Applying the "histogram equalization mapping" as

disclosed in Zimmerman is analogous to performing contrast stretching as recited in the claim. Also note

that this is applied on a pixel-by-pixel basis and is determined according to the dynamic range of the local

neighborhood.

With regard to claim 17, Zimmerman discloses a processor for determining dynamic ranges of

pixel neighborhoods for the pixels of interest (Zimmerman pg. 305 left column, final paragraph). The

local distribution of pixel intensities as disclosed in Zimmerman is analogous to the dynamic range as

recited in the claim. Zimmerman further discloses performing contrast stretching on a pixel-by-pixel

basis on each pixel of interest within the dynamic range of the corresponding pixel neighborhood

(Zimmerman pg. 305 left column, final paragraph). Although Zimmerman does not explicitly state that a

processor is performing these steps, a processor would have to exist in order for these operations to be

performed. Therefore, a processor is inherent in Zimmerman's disclosure. Also inherent in Zimmerman

is the further limitation that contrast stretching is performed on each pixel of interest "within" the

dynamic range of the pixel neighborhood. Any pixel of interest in a local neighborhood inherently lies

within the dynamic range of that neighborhood.

Claim Rejections - 35 USC § 103

4.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness

rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the
manner in which the invention was made.

5.   Claims 2, 3, 30 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lee as

applied in claim 1 above and further in view of Zimmerman. The arguments as to the relevance of Lee as

applied in paragraph 2 above are incorporated herein.

Referring to claim 2, Lee discloses a variable range but not does not expressly disclose that the

variable range for each pixel is a function of dynamic range of a local pixel neighborhood and is

determined on a pixel-by-pixel basis. Zimmerman, however, discloses determining variable range on a

pixel-by-pixel basis and as a function of the dynamic range of a local pixel neighborhood (Zimmerman

pg. 305, left column, final paragraph). The "local distribution of pixel intensities" in a "contextual

region" as disclosed in Zimmerman is analogous to the dynamic range of a local pixel neighborhood as

recited in the claim.

It would have been obvious to one reasonably skilled in the art at the time of the invention to

modify Lee's image processing method by determining the variable range on a pixel-by-pixel basis and as

a function of a local pixel neighborhood as taught by Zimmerman. Such a modification would have

allowed for a method that clipped and mapped pixel intensity values on an adaptive basis rather than on

the global information content of the image This would have made for a more robust system that could

make objects of differing intensity value subranges simultaneously visible (Zimmerman pg. 305 left

column, final paragraph).

With regard to claim 3, the combination of Lee and Zimmerman discloses an image processing

system in which pixel values are mapped inside a variable range and clipped outside of a variable range.

Said variable range being determined on a pixel-by-pixel basis as a function of the dynamic range of the

local pixel neighborhood. Lee discloses calculating "low-clipping" and "high-clipping" points which

determine the variable range. In such a system, the dynamic range a local pixel neighborhood would

approach zero when the intensity values of all the pixels in the neighborhood were nearly the same.

Consequently the low and high clipping points would be the same and the output intensity value of the target pixel would be the same as the input intensity. When the output values of a system are the same as the input values, this is well known in the art as mapping with a slope of unity. Consequently, this limitation, although not explicitly disclosed, is inherent in the combination of Lee and Zimmerman.

Additionally, in a situation where there is a variance between the pixel values of a local neighborhood, we can say that the dynamic range of the neighborhood is greater than zero and there will be a positive difference between "low" and "high" clipping points . As a result, mapping the target pixel values using a slope greater than unity, although not expressly disclosed in the Lee and Zimmerman combination, is inherent in the system.

In addition, a greater dynamic range will result in "low" and "high" clipping points which are further apart and require a greater sloped line to map them together. As a result, the further limitation that the slope of the mapping function is a non-decreasing function of the dynamic range is inherent in the combination of Lee and Zimmerman.

With regard to claims 30 and 31, a program stored in memory which causes the computer to execute the steps of a method is essential if the image processing method disclosed in Lee is to function. Therefore, a program stored in memory is inherent in the teachings of Lee and Zimmerman.

6.   Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lee as applied to claim 1 above, and further in view of Gu (USPN 6,097,853). Lee discloses all of the limitations of claim 8, but does not expressly disclose the further limitation that the image is a color image and that the luminance channel is processed and then combined with the chrominance information. Gu, however, discloses performing sharpening on the luminance channel of a color image (Gu column 13 lines 9-11) and then combining the luminance channel of the image with the chrominance information (Gu column 14 lines 38-46). Gu does not explicitly state that the luminance and chrominance information is combined, but the

cited passages in conjunction with Figure 2 show a system which performs processing on the isolated

luminance channel and then performing processing on the image with color data included. As a result,

the recombination of these signals is inherently taught.

It would have been obvious to one reasonably skilled in the art at the time of the invention to

modify Lee's image processing system in order to include the sharpening of the luminance channel of a

color image as taught by Gu. Such a modification would have allowed for a more robust sytem that could

perform sharpening on color images.

7.   Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Lee

and Gu as applied to claim 8 above, and further in view of Sani et al. (US Patent Application Publication

2003/0020830). The arguments as to the relevance of Lee and Gu as applied in paragraph 6 above are

incorporated herein. The combination of Lee and Gu discloses sharpening a color image, but does not

expressly disclose converting the image from RGB color space to YCbCr color space prior to sharpening.

Sani, however, discloses converting a digital image from RGB color space to YCrCb color space prior to

image processing (Sani paragraph 23 with Figures 1a and 1b).

It would have been obvious to one reasonably skilled in the art at the time of the invention to

modify the combination of Lee and Gu's color image sharpening system to include conversion of the

color image from RGB color space to YCrCb color space prior to processing as taught by Sani.

Converting the color space of the image prior to sharpening would have allowed for a conventional

method of splitting the luminance and chrominance signals prior to sharpening (Sani paragraph 23).

8.   Claims 11, 12, 18 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over

Zimmerman as applied to claim 10, and further in view of Zimmerman. The arguments as to the

relevance of Zimmerman as applied in paragraph 3 above are incorporated herein.

Claim 11 incorporates all of the limitations of claim 10 and further adds the limitations that the contrast stretching is performed by clipping pixel values outside of a contrast range and mapping pixel values inside a contrast range. The embodiment of Zimmerman applied to claim 10 discloses performing a contrast stretching on a pixel of interest on the basis of the dynamic range of that pixel's local neighborhood. This embodiment also discloses mapping pixel intensity values. The embodiment fails to expressly disclose that the mapping is performed only on pixels within a contrast range and that the pixels outside of a contrast range are clipped.

Zimmerman, however, additionally discloses mapping the intensity values which fall within a given range, and clipping the intensity values which fall outside that range (Zimmerman pg. 304, right column, final paragraph). The sentence "Intensity values lying above or below the window are mapped to the maximum and minimum possible intensity values, respectively" is simply describing the operation of clipping as recited in the claim. Zimmerman teaches that this additional embodiment 'enhances contrast within a subrange of intensity values at the expense of the remaining values'.

It would have been obvious to one reasonably skilled in the art at the time of the invention to modify the local adaptive, pixel-by-pixel method of contrast stretching shown in one embodiment of Zimmerman, by including the mapping and clipping operations as taught by the additional Zimmerman embodiment. Such a modification would have resulted in a contrast enhancing system in which intensity subranges could be adaptively enhanced on the basis of a target pixel's neighborhood pixel data. Consequently, the contrast enhancement operation would provide full enhancement of an image without any loss of information.

With regard to claim 12, the combination of the Zimmerman embodiments discloses a system in which mapping is adaptive to the local distribution of pixel intensities. As a result, we can conclude that a local pixel neighborhood which lacked a distribution of pixel intensities (dynamic range of zero) wouldn't be mapped at all. Rather, the ouput would simply be the same as the input. When the output

values of a system are the same as the input values, this is well known in the art as mapping with a slope

of unity. Consequently, this limitation, althought not explicitly disclosed, is inherent in the combination

of the Zimmerman embodiments.

Since the contrast enhancing operation is based on the local distribution of pixel intensities about

a target pixel, we can conclude that a distribution with a greater magnitude will result in a target pixel

being mapped with a greater magnitude. Consequently, we can conclude that the mapping slope is greater

than unity when the dynamic range is greater than zero and the slope is a non-decreasing function of the

dynamic range. Although not expressly disclosed, these limitation are inherently taught by the

combination of Zimmerman embodiments.

With regard to claims 18 and 19, all of the limitations of the claims have been addressed in the

above arguments, but Zimmerman fails to explicitly state that a processor is performing the operations.

However, a processor would have to exist in order for these operations to be performed. Therefore, a

processor is inherent in Zimmerman's disclosure.

9.   Claims 23-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Burke (USPN

5,042,077) in view of Zimmerman.

With regard to claim 23, Burke discloses determining a contrast range for each pixel of interest in

a digital image, clipping intensity values of pixels of interest if they lie outside a contrast range and

mapping intensity values of pixels of interest which lie within the contrast range (Burke column 2 lines

34-50). The contrast window disclosed in Burke is analogous to contrast range as recited in the claim.

This embodiment of Burke fails to expressly disclose that this contrast range is determined on a pixel-by-

pixel basis. Zimmerman, however, discloses determining a contrast range on a pixel-by-pixel basis

(Zimmerman pg 305 left column, final paragraph). The claim also recites an apparatus for performing

these operations. A processor would have to exist in order for these operations to be performed. Therefore, a processor is inherently taught in the combination of Burke and Zimmerman.

It would have been obvious to one reasonably skilled in the art at the time of the invention to modify the sharpening (contrast enhancing) method of mapping and clipping pixel intensity values disclosed in Burke, by determining a contrast range on a pixel-by-pixel basis as taught by Zimmerman. Such a modification would have allowed for a contrast enhancement method that could be adaptively performed on the basis of pixel values in a local pixel neighborhood. This would have resulted in a contrast enhancement method that would automatically vary the enhancement for different types of image regions.

With regard to claim 24, Zimmerman discloses that contrast range is a function of a dynamic range of a local pixel neighborhood and is determined on a pixel-by-pixel basis (Zimmerman pg. 305 left column final paragraph). The contextual region disclosed in Zimmerman is analogous to the local pixel neighborhood as recited in the claim. The "local distribution of pixel intensities" disclosed in Zimmerman is analogous to the dynamic range recited in the claim.

With regard to claim 25, the combination of Burke and Zimmerman discloses a system in which mapping is adaptive to the local distribution of pixel intensities. As a result, we can conclude that a local pixel neighborhood which lacked a distribution of pixel intensities (dynamic range of zero) wouldn't be mapped at all. Rather, the ouput would simply be the same as the input. When the output values of a system are the same as the input values, this is well known in the art as mapping with a slope of unity. Consequently, this limitation, although not explicitly disclosed, is inherent in the combination of Burke and Zimmerman.

Since the contrast enhancing operation is based on the local distribution of pixel intensities about a target pixel, we can conclude that a distribution with a greater magnitude will result in a target pixel being mapped with a greater magnitude. Consequently, we can conclude that the mapping slope is greater

than unity when the dynamic range is greater than zero and the slope is a non-decreasing function of the dynamic range. Although not expressly disclosed, these limitation are inherently taught by the combination of Burke and Zimmerman.

Allowable Subject Matter

10.   Claims 4-7, 13-16, 20-22, 26-28 and 32-34 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

11.   The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Mahmoodi (USPN 5,774,601)

Shin et al. (USPN 5,524,070)

Kuo et al. (USPN 5,982,926)

Bamberger et al. (USPN 5,970,164)

Rattey et al. (USPN 5,289,549)

Arias (USPN 5,966,134)

Kondo et al. (USPN 6,298,085)

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Patrick L Edwards whose telephone number is (703) 305-6301. The examiner can normally be reached on 8:30am - 5:00pm M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Leo

Boudreau can be reached on (703) 305-4706. The fax phone number for the organization where this

application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should

be directed to the receptionist whose telephone number is (703) 305-3900.

Patrick Lynn Edwards   Art Unit 2621

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